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SCIENTIFIC ASSEMBLY UPDATE

Paediatrics in Berlin

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ABSTRACT: The aim of this report is to describe the highlights of the European Respiratory Society annual congress in Berlin, Germany. The best abstracts in asthma and allergy, cystic fibrosis, respiratory infection, paediatric and neonatal intensive care, paediatric investigative techniques (in particular respiratory physiology and bronchoscopy) and respiratory epidemiology are presented and set in the context of the current literature.

KEYWORDS: Asthma, cystic fibrosis, intensive care, lung function, primary ciliary dyskinesia, respiratory infection

The European Respiratory Society (ERS) congress in Berlin, Germany contained numerous high-quality scientific presentations. In view of the many, sometimes unavoidably conflicting, sessions and as a service to those who could not attend, in this article we review the pick of the paediatric assembly abstracts, selected by members of each group, nominated by the group chair, and set in the context of the paediatric literature.

ASTHMA AND ALLERGY

Pre-school wheeze

Recently, the final report of an ERS task force on the definition, assessment and treatment of wheezing in pre-school children was published [1]. The authors clearly stated that there is a lack of high-level evidence for most recommendations; however, for clinical purposes, the task force recommended describing pre-school wheeze as episodic (viral) wheeze or multi-trigger wheeze. SCHULTZ *et al.* [2] showed that these two wheezing phenotypes (episodic (viral) and multi-trigger) are not stable over time. At least 25% of children had variable wheezing phenotypes during 1 yr of follow-up, and phenotype at the start did not predict phenotype at the end of the study. Clearly, wheeze phenotypes may change with treatment (*e.g.* treatment with inhaled corticosteroids abolishing interval symptoms, apparently converting multi-trigger wheeze into episodic (viral) wheeze) and with the passage of time, as interval symptoms develop in association with aeroallergen sensitisation (see below). This means a flexible approach is needed to the ''phenotype-driven'' treatment at this young age, as proposed by the task force. Searching for determinants of phenotypes, MOELLER *et al*. [3] pointed out that children with persistent asthma at school age had elevated exhaled nitric oxide fraction (*Fe*NO) when they were pre-schoolers. Although data on predictive values of *Fe*NO were not presented, the study suggested that pre-school wheezers with elevated *Fe*NO values are at risk for persistent asthma. However, the current difficulty is to know how to prevent the progression to asthma, since neither intermittent [4] nor continuous [5, 6] inhaled corticosteroids modify disease.

A study from Serbia showed that sensitisation to aeroallergens in pre-school children with symptoms of allergic disease is quite common, with up to 72% of 5-yr-olds being sensitised to house dust mite [7]. Early sensitisation, in particular in combination with exposure to allergens, predicted the loss of lung function and the development of airway hyperresponsiveness at school age, which is in line with the recent work of ILLI *et al.* [8] and KAMENOV *et al*. [9]. This means that young children who are sensitised and exposed to allergens should be monitored very carefully in an attempt to prevent impairment of lung function.

Difficult to treat asthma

A small subgroup of children with asthma (probably <5%) have more troublesome disease reflected by persistent symptoms, asthma exacerbations or airflow obstruction, despite high medication use [10]. Recently, novel nomenclature has been proposed [11]. The umbrella term ''problematic severe asthma'' covers all children who are referred to a specialist clinic with either chronic symptoms or acute deteriorations, or both,

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despite maximal standard therapy. These need to be divided into patients with ''difficult'' asthma, and those with true, severe, therapy-resistant asthma. HALL *et al.* [12] have stressed once again that searching for remediable factors pays off. Half of ''problematic, severe asthma'' patients had psychological problems, poor adherence or were exposed to environmental tobacco smoke or an excessive allergen burden in the home. Those patients may not need to enter a full work-up for difficult to treat asthma, and are certainly not candidates for novel molecular therapies [12]. In those who did enter such a work-up, including bronchoscopy with endobronchial biopsies, only a minority responded fully to a course of oral or parenteral steroids [13]. The thickness of the basement membrane, considered as one of the hallmarks of asthma, was not related to steroid sensitivity or persistent airflow limitation, stressing the heterogeneity of this group of patients and the need for a systematic approach [14].

Asthma control

Recently, the concept of asthma control was put forward in asthma guidelines as central in the management of asthma [15–17]. However, in children there is no agreement on how to monitor asthma to achieve optimal control and adapt treatment accordingly. Several abstracts studied the usefulness of the asthma control test (ACT) and *F*eNO in assessing asthma control and directing treatment choices.

SAITO *et al.* [18] showed that *F*eNO correlated with the ACT and a cut-off of *F*eNO of 57 ppb had the best discriminatory power for uncontrolled asthma, as assessed with the ACT. In contrast, others could not confirm a predictive value for *F*eNO as a marker of asthma control, as assessed by the ACT or symptoms scores [19, 20]. ROBROEKS *et al.* [21] attempted to predict exacerbations by the level of asthma control (assessed with the ACT), *F*eNO and markers in exhaled breath condensate (EBC). The ACT and several markers in EBC, but not *F*eNO and forced expiratory volume in 1 s (FEV_1), were partially predictive of exacerbations. Taken together, these data suggest that symptoms, lung function and inflammatory markers reflect different aspects of the heterogeneous asthma phenotype and probably combinations of these should be considered in order to optimise treatment in individual patients.

Is asthma an allergic disease?

In children the majority of asthma exacerbations are associated with upper respiratory viral infections. With the availability of newer and more sensitive molecular assays, rhinovirus has gained increasing attention [22]. In Australia, 83% of children presenting to the emergency room with acute asthma had detectable human rhinovirus in nasal aspirates [23]. Recent work has stressed the interactions between allergen exposure, allergic sensitisation and viral infection in children admitted to hospital with an asthma exacerbation [24]. The intriguing finding of bacterial chronic mucosal infection in wheezy pre-school children opens up the possibility that asthma may be associated with, or causally related to, a subtle immune deficiency.

CYSTIC FIBROSIS

Infant lung function studies in babies clinically diagnosed with cystic fibrosis (CF) have demonstrated lowered lung function at the time of diagnosis that did not normalise even with aggressive therapy [26, 27]. Potentially, newborn screening could ensure earlier diagnosis and enable intervention before damage to the lung has occurred. Recent studies from Australia have indicated that lung function is normal in screened infants in the first 6 months of life, but deteriorates thereafter [28]. Recent publications have now demonstrated that this lung function decline is associated with inflammation and the development of bronchiectasis on computed tomography (CT) scans [29, 30]. This is concerning as it shows that current treatment strategies are unable to avoid early structural damage in CF.

CT scanning has also been proposed to be a sensitive technique for the detection of gas trapping in CF. Interestingly, a study using a validated CT score did not observe any correlation between gas trapping detected by CT and lung function testing [31]. This may be due to differences in the child's posture for the two techniques (supine for CT, sitting for lung function testing), but raises the question as to how reliable CT will be in defining this important aspect of CF lung disease.

Many groups are currently assessing lung function tests that may be more sensitive than FEV_1 [32]. The lung clearance index (LCI), as well as other derived measures obtained by multiple breath washout (MBW), show considerable promise for early detection of abnormalities [33, 34]. OLIVER *et al.* [35] found that LCI in pre-school CF children, as well as being higher than normals, rises more rapidly with age and predicts LCI at school age. So far, limited evidence exists as to whether the LCI is responsive to interventions. Two studies assessing LCI before and after physiotherapy failed to demonstrate consistent changes [36, 37]. However, this may not be the ideal model, as the evidence that physiotherapy has an immediate effect on lung function is not strong [38]. These techniques are discussed in more detail below. SCRASE *et al.* [39] showed a significant reduction in LCI after intravenous antibiotics, but the group change was disappointingly small (13.3 to 12.6) and masked a variable response which bore no relation to changes in functional residual capacity.

Nitric oxide is reduced in CF airways, and this may have important consequences for airway infection and inflammation. Polyunsaturated fat supplementation has been proposed to be an anti-inflammatory therapy in CF. In a blinded study, KEEN *et al.* [40] showed that supplementation raised airway nitric oxide levels, whereas a saturated fat-rich diet further depressed nitric oxide concentrations. Whether this results in clinically relevant changes in airway inflammation still needs to be elucidated, as *F*eNO is not a reliable marker of either disease severity or inflammation in CF patients [41]. This is supported by work of ROBROEKS *et al.* [42] who have assessed *F*eNO and EBC as predictors of a pulmonary exacerbation. *F*eNO was not found to be useful, but EBC pro-inflammatory cytokines, such as tumour necrosis factor-α and interleukin (IL)-8, predicted future pulmonary exacerbations [16]. These interesting observations will need to replicated, but offer new hope for noninvasive measures of airway inflammation for future studies.

RESPIRATORY INFECTION

Host defence against mycobacteria is dependent on the function of the IL-12–interferon (IFN)-γ pathway. Mutations in five genes regulating this pathway cause 10 syndromes of

Mendelian susceptibility to mycobacterial diseases (MSMD), with normal immunity to other microbes. For each mutation, both partial and complete deficiencies have been recognised. If vaccinated with bacillus Calmette–Guérin (BCG), patients suffer from invasive early-life BCG infections. In later childhood, the patients suffer from invasive infections caused by atypical mycobacteria, with no increased susceptibility to *Mycobacterium tuberculosis* [43]. KHALILZADEH *et al.* [44] presented the findings of 16 Iranian children with disseminated BCG disease. MSMD was diagnosed in six patients: IL-12 receptor(R)-1 deficiency in three, IL-12p40 production deficiency in two and IFN-γR2 deficiency in one case, but IFN-γR1 deficiency, which has been found in other populations, was not reported. Complete receptor deficiencies are fatal, and human stem cell transplantation (HSCT) is the only curative treatment. If there is a family history of generalised infections caused by BCG or atypical mycobacteria, then children should be studied for IL-12/IFN-γ pathway prior to BCG vaccination. First, the abnormality in the function of IL-12/IFN-γ pathway should be documented and localised in cell cultures,and then the gene defect can be determined [43]. It is important that this is discussed at an early stage with a genetic laboratory specialising in this condition.

Pulmonary complications are common in children with primary immunodeficiency (PID). BOUKARI *et al.* [45] presented a series of 61 Algerian children: 34 agammaglobulinaemia, six ataxia-telangiectasia, 11 severe combined immunodeficiency (SCID) and seven chronic granulomatous disease (CGD). The median age at diagnosis was 4.0 yrs and the median time of diagnosis from first symptoms 3.2 yrs. Bronchiectasis developed in 35 (57%) children. All 12 deaths were due to pulmonary complications. DMENSKA *et al.* [46] presented a series of 19 Polish children with hyperimmunoglobulin-E syndrome, characterised by recurrent staphylococcal abscesses, cyst-forming pneumonias and serum IgE $>2{,}000$ IU·mL^{-1}. Seven had experienced severe pulmonary complications, and five had undergone lobectomy. An early diagnosis of PID, with institution of treatment as appropriate, such as the introduction of gammaglobulin replacement therapy, prevention of infection, and early HSCT for SCID and CGD are a challenge in all countries [47]. Moreover, complication rates can be high after HSCT. Among 186 children with HSCT carried out for malignant and nonmalignant disorders, 50 (24%) developed pulmonary post-HSCT complications, leading to death in 27 cases [48]. Elevated cytokine levels in bronchoalveolar lavage (BAL) fluid after HSCT predicted later pulmonary complications.

Whooping cough caused by *Bordetella pertussis* may be dangerous in young unvaccinated infants, and recent studies have revealed the occurrence of mixed infections with respiratory viruses [49]. Older children and young adults, though vaccinated as infants, may have *B. pertussis* infection which presents with persistent non-whooping cough. Among 36 Spanish school-aged children with pertussis, the cough lasted 16 weeks on average, and 67% of the patients had received asthma medication [50]. Whooping cough is often forgotten, and should be considered if, in particular, an incompletely vaccinated infant has a prolonged cough. In a small study, which nonetheless highlights an important clinical point, of 19 Lithuanian infants aged <9 months who had coughed for >14 days with a presumed respiratory infection, *B. pertussis* immunoglobulin (Ig)A or IgM antibodies were positive in 15 (79%) cases. Only one child had reached the age to be fully vaccinated [51]. Whooping cough should be considered, if an incompletely vaccinated infant has cough, and at that age, the preferred diagnostic test is PCR [49]. Many countries have started booster vaccinations for older children with currently available effective and safe acellular vaccine [52].

In some developed countries, the prevalence of childhood non-CF bronchiectasis is rather low, but elsewhere, particularly in the developing world, bronchiectasis has remained common [53]. In addition to socioeconomic factors, there may be genetically determined differences between different populations. Consanguinity (present in 95%) and siblings with bronchiectasis or symptoms probably due to bronchiectasis (94%) were significant risk factors in 73 Tunisian children with bronchiectasis [54]. *Helicobacter pylori* has been thought by some [55] but not by others [56, 57] to predispose children to bronchiectasis, possibly through gastro-oesophageal reflux and consequent aspiration. However, *Helicobacter pylori* had no role in a Turkish study of bronchiectasis [58].

In addition to scientific news, clinicians consider case presentations useful. Among the pearls were the posters on scimitar syndrome [59] and on pulmonary echinococcosis [60]. When a child suffers from recurrent episodes of, in particular, focal lung infections, anatomical abnormalities should be considered. A careful examination of the chest radiograph may give evidence for the underlying illness, such as a shadow resembling scimitar. There is an anomalous connection of the pulmonary veins to the inferior vena cava, with a variable degree of pulmonary hypoplasia and malformed pulmonary arteries. The need for surgical correction depends on the haemodynamic consequences. The case with pulmonary echinococcosis presented with eosinophilia and a thick-wall, 6×7 cm cavity in the lung. *Echinococcus granulosus* was found in pleural fluid. The child was successfully treated with a 1-month course of albendazole, followed by surgical removal of the echinococcal cavity.

PAEDIATRIC AND NEONATAL INTENSIVE CARE

Respiratory assessment of newborn infants

Currently therapy for newborn infants with established respiratory disease, such as chronic lung disease (CLD) of prematurity or bronchopulmonary dysplasia, is more of an art than a science. For many years, there has been an ongoing search for tools to assess respiratory function in newborn infants. Thus far, most have largely been confined to research laboratories [61]. Clearly, accurate estimation of lung function parameters would be useful in guiding therapy, including optimisation of ventilation, and in assessing success of potential therapeutic interventions. There are newer techniques which, at least in theory, seem promising: for example, ultrasound or magnetic resonance imaging, both of which are increasingly used antenatally, may provide accurate estimations of lung volumes, which are particularly useful for diseases such as congenital diaphragmatic hernia [62]. Other promising techniques for the assessment of lung volumes and lung homogeneity including optolectronic plethysmography, electrical impedance tomography and MBW of SF_6 [63–65]. Another area of interest is the assessment of pulmonary

arterial pressure without resorting to unsatisfactory invasive methods [66]. Tools such as tissue Doppler imaging have shown promise in studies in adults [67] and certainly show promise in newborn infants [68]. Although these techniques are being introduced into clinical practice, their application to specific areas needs careful evaluation and standardisation to permit comparisons between units and patient groups.

Outcomes of neonatal intensive care

Another important area of interest in neonatal medicine is the outcomes of graduates of the newborn intensive care nursery [69]. Major advances, including the routine use of exogenous surfactant, antenatal corticosteroids and use of gentle ventilation, has decreased mortality but respiratory outcomes remain a concern. VRIJLANDT *et al.* [70] have previously shown that respiratory symptoms remain common in pre-term infants as they reach school age, but interestingly they reported that moderately premature infants of between 32 and 32+6 weeks' gestation also have more symptoms than their term counterparts at the age of 3–4 yrs [71]. Long-term studies appear to show tracking of lung function of pre-term infants [72] but clearly further work is required to understand the factors which influence these outcomes, including the interactions of nutrition and respiratory infections with the consequences of prematurity.

A link between respiratory and cardiovascular disease in conditions such as chronic pulmonary obstructive disease [73] and in adults with CF [74] is being increasingly recognised. The origins of such links are uncertain but are being increasingly investigated in childhood, thus developing the Barker hypothesis of the early origins of diseases [75]. BOLTON *et al.* [76] showed that increased arterial stiffness was observed by the age of 11 yrs in infants born extremely prematurely (<26 weeks, EPICURE study). Further studies are needed in order to understand the implications of these findings.

INVESTIGATIVE TECHNIQUES IN PAEDIATRIC RESPIRATORY MEDICINE

Physiological tests

The paediatric respiratory physiology group had a strong ''bench to bedside'' flavour, with two main themes emerging: use of recently standardised techniques to study treatment and progression in respiratory diseases such as CF; and a renewal of interest in noninvasive techniques likely to be more widely applicable in clinical practice.

The MBW technique has emerged as a promising tool in the last few years [77–79]. Most publications so far have used a mass spectrometer to measure marker gas concentrations, but such systems are expensive and not commercially available, limiting the applicability of the technique. Several presentations featured commercial MBW systems using ultrasonic flow sensors or photoacoustic techniques to measure SF_6, with encouraging results after some modification. FUCHS and GAPPA [80] showed excellent within- and between-test variability for a sidestream modification of the ultrasonic system (EcoMedics, Duernten, Switzerland). MCLEOD *et al.* [81] demonstrated significant errors using the photoacoustic system (Innocor; Innovision, Odense, Denmark) in an infant lung model, but were able to reduce these by modifying the analyser rise time. HATZIAGOROU *et al.* [82], using an unmodified mainstream ultrasonic system, showed significantly higher LCI in preschool children with CF compared with healthy controls, though with control LCI values higher than most published values. There was a renewal of interest in simple noninvasive techniques usable in infants without sedation. LATZIN *et al.* [83] presented normal values, collected in 241 unsedated healthy neonates, for tidal breathing parameters, MBW and interrupter resistance (R_{int}). Surprisingly, R_{int} measurements were higher when longer (500 ms) occlusions were used, possibly because repeated Hering–Breuer manoeuvres may have altered end-expiratory level. This illustrates just how complex a phenomenon tidal breathing is in infants. This group have previously observed that infants with CLD not only reach peak flow earlier in tidal expiration, but have less variable tidal breathing parameters than healthy infants, and have suggested this is due to mechanical constraints restricting their freedom to modulate expiratory braking. Taking this further, HUTTEN *et al.* [84] showed that infants with CLD do, indeed, have shorter and less variable diaphragmatic braking, and that, unlike in normal infants, this does not seem to determine their functional residual capacity.

Tidal breathing measurements usually require a mask on the face, which can disturb breathing pattern and is problematic in sick and older infants. Two presentations explored alternative ways of making respiratory measurements in quiet unsedated infants. FOSTER *et al.* [85] used electrical impedance tomography to question current teaching that the dependent lung in side-lying infants is poorly ventilated, while OLDEN *et al.* [86] showed that useful respiratory data (allowing accurate estimation of respiratory rate) could be extracted from the raw signal of a pulse oximeter.

Bronchoscopy and BAL

Fibreoptic bronchoscopy (FOB) is one of the major tools for evaluating respiratory disorders in children and its diagnostic value is widely accepted. It can be also useful therapeutically [87]. The first task of the bronchoscopist is the visualisation of upper and lower airways, including both their morphology and mobility. The associated procedures, such as BAL, bronchial brushing and endobronchial biopsies, permit samples to be taken to gain more information about inflammatory processes involved in different airway diseases.

All these procedures carried out during FOB, if performed by skilled physicians working with a good team, have been proved to be safe and useful, without significant side-effects [88]. In patients with persistent stridor, FOB can help to diagnose different forms of laryngomalacia or aspiration syndromes. Tumours are rarely detected as cause of stridor [89]. Direct visualisation of the lower airways is helpful in diagnosing bronchial stenosis. The cause of bronchial stenosis can be intrabronchial (*e.g.* foreign bodies [90], granulation tissue, mucus plugs, tumours such as bronchial carcinoids and leiomyomas [91]) or extrabronchial (lymphadenopathy and mediastinal tumours). The prevalence of different causes varies between centres [92].

FOB allows the visualisation of primary or secondary bronchomalacia of main stem bronchi even in newborns and infants. Right bronchomalacia may sometimes be treatable with an endobronchial stent [93]; the stent may cause

numerous problems (mucus retention, granulation tissue and migration of the stent, *etc*.). In left bronchomalacia, some propose the performance of bronchopexy, which entails surgical suspension of the left main bronchus superiorly to the ligament of Botallo [94]. Rare causes of stenosis of subsegmental bronchi are plastic bronchitis, associated with asthma, recurrent pneumonia, CF and the post-operative period after the Fontan procedure for congenital heart disease. Plastic bronchitis is characterised by the formation of obstructing endobronchial casts which can be removed by FOB [95, 96].

BAL allows the study of cells and mediators coming from the bronchoalveolar compartment, and the detection of bacteria, viruses, fungi and protozoa. In asthmatic patients it allows the study of inflammatory processes in the lower airways. In these patients, BAL cell count does not necessarily reflect that of bronchial mucosal biopsies [97, 98] and combining BAL and biopsy can give more information about inflammatory mediators than either technique alone [99]. BAL cell count and culture also is occasionally useful in making a definitive diagnosis of diffuse lung disease in children [100]. BAL can be used therapeutically. The role in the treatment of alveolar proteinosis and the removal of inhaled material from lower airways is well known. Another example is the clearance of inhaled mineral oil, used as a purgative agent for partial bowel obstruction due to *Ascaris lumbricoides* [101], or of inhaled skin oils, used for baby care.

Nowadays, rigid bronchoscopy is utilised in childhood less often than in the past; it is recommended, above all, for removal of inhaled foreign bodies. Foreign body aspiration is common in children aged <3 yrs and represents an important cause of morbidity and even mortality. The combination of suggestive history, unilaterally decreased breath sounds and hyperinflation on the chest radiograph has a positive predictive value of 88% for foreign body inhalation [102]. When there is this high suspicion, it is mandatory to submit the patient for rigid bronchoscopy.

RESPIRATORY EPIDEMIOLOGY

Early life risk factors for childhood asthma: evidence from birth cohort studies

Novel data from large birth cohorts underline the role of intrauterine life and early post-natal environment in the pathogenesis of childhood asthma. A study of fetal measurements at 10 and 20 weeks of gestation from Aberdeen, UK provided further evidence for an association between fetal growth and both asthma symptoms and lung function in preschool children [103, 104]. This seemed to be particularly true when fetal measurements were low at both time points in pregnancy. Provocative data on potential pre-natal risk factors also came from Bristol, UK and Bern, Switzerland: in a carefully conducted analysis of the ALSPAC (Avon longitudinal study of parents and children) cohort, adjusting for numerous confounders, GRANELL *et al.* [105] suggested that maternal anxiety during pregnancy might increase the risk of nonatopic asthma in the offspring; LATZIN *et al*. [106], conversely, proposed an association between pre-natal exposure to air pollution and lung function in newborns. Clearly, both studies need replication in independent cohorts before firmer conclusions can be drawn, and the underlying pathophysiological mechanisms will need to be elucidated.

Several presentations further refined the data relating to pre-natal farm exposure and childhood asthma: using data from five European countries, ROCHAT *et al.* [107] suggested that the protective effect of farming environment might be mediated through the activation of T-suppressor cells. Some discussion arose around the fact that the one country with discrepant results (Switzerland) was excluded from the analysis, being considered an outlier. EGE *et al*. [108] presented a series of analyses on the effects of maternal farm exposure during pregnancy and maternal immunity to *Toxoplasma gondii* and rubella virus on atopic sensitisation in children, with some evidence for an effect modification. ILLI *et al*. [109] showed data from an urban cohort in Munich, Germany suggesting that crowding might reduce the risk of childhood eczema, and that early exposure to endotoxins might also have a protective effect on the development of atopy in an urban and affluent setting. Two other contributions shared a more sceptical view on some aspects of the hygiene hypothesis. CAUDRI *et al.* [110] presented carefully analysed longitudinal data from the PIAMA (prevention and incidence of asthma and mite allergy) cohort on early day-care and its association with a number of outcomes assessed in yearly intervals. An association was found between early day care and an increased risk of respiratory infections and wheezing in the first years of life, but no evidence for a protection against wheezing, asthma and atopic sensitisation during later years was found. Somewhat in line with that, data from Leicester, UK presented by STRIPPOLI *et al*. [111] suggested a protective role of prolonged breastfeeding against episodes of wheeze in infancy, but no association with respiratory outcomes later in childhood. The fact that severity of wheeze [112] and lung function measurements [113] track strongly from the pre-school years underlines the potential impact of these early hazards on long-term development of these children.

Epidemiology of primary ciliary dyskinesia in children

Primary ciliary dyskinesia (PCD) is a rare autosomal recessive disease impairing mucociliary clearance and causing chronic disease of the upper and lower airways [114, 115]. There are no good international data on prevalence, age at diagnosis, burden of disease, management and prognosis. The information that is available on clinical presentation and age at diagnosis comes from a few case series in single countries [116, 117]. An additional large series of 67 patients from Argentina was presented in Berlin, suggesting that morbidity in children aged ⩾12 yrs is considerable, with impaired lung function and bronchiectasis in all children [118]. To improve the knowledge on the epidemiology of PCD, the ERS taskforce on PCD in children performed a questionnaire survey in 25 European countries. In total, 214 centres replied, with an average response rate from tertiary care centres of 52%. Individual data from >1,100 patients were collected and first presented at this conference [119, 120]. Results, particularly from Cyprus, Denmark and Switzerland, suggest that prevalence might be higher than previously thought and approach 1 in 10,000, rather than the 1 in 30,000 previously estimated [121]. Median age at diagnosis in the reported patients was 5 yrs, lower in those with situs inversus compared to those without (3.0 *versus* 6.0 yrs; $p<0.001$), and with considerable international differences. Standard treatment varied considerably between centres and across countries. The proportion of centres prescribing the

following treatments routinely to all patients was: airway clearance therapy 71%; encouragement of exercise 64%; immediate treatment of exacerbations with antibiotics 79%; inhaled bronchodilators 27%; and inhaled corticosteroids 12% [120]. This heterogeneity reflects the poor knowledge base on the effectiveness of these therapies in children with PCD. Depending on funding, the database of PCD centres built up by the task force could serve as a starting point for an international PCD registry assessing clinical and physiological data and including long-term follow-up. In addition, it could be used for planning therapeutic multicentre trials.

STATEMENT OF INTEREST

None declared.

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